

A photographic essay on the development of seed cones in *Juniperus arizonica*

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ABSTRACT

During the course of observing pollination and seed cone development in local species of *Juniperus*, macro- and micro-photography was used to record changes in the external morphology of developing seed cones of *J. arizonica*.

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As far as known, there are no chronological images the macro-development of seed cones in *J. arizonica* (Fig. 1). This photographic essay is presented to spur new research into the fertilization and development of seed cones in *Juniperus*.

Figure 1. mature, rose-colored seed cones of *J. arizonica*.



Ottley (1909) wrote the seminal paper on fertilization in *J. communis* and *J. virginiana*. However, that detailed study seems to have been scarcely followed up. Among her astute observations, she noted that fertilization in *J. communis* occurs about one year after pollination, but after about 1 to 2 months in *J. virginiana*. A photographic record of macro-development is important in the study of taxonomy of *Juniperus*, as it enables the observer to more clearly distinguish male from female trees and to differentiate between immature normal cones and insect galls.

In the course of observing differences between seed cones (Adams, 2014), we have noticed the pattern of development in Arizona and herein present a photographic record of seed cone development in *J. arizonica*.

Pollen of *J. arizonica* was observed shedding from Jan to March, 2014 at this Arizona location. The first observed indication of pollination was observed and photographed on 20 Jan. 2014.

METHODS

From Jan 20, 2014 to Nov 5, 2014 photographs were taken on a single *J. arizonica* tree as its flowers matured to rose-red seed cones. The site is located about 3 miles SW of Cottonwood, Az, at Quail Springs Ranch, 34° 41' 16.458" N, 112° 03' 04.982" W, elevation 4090 ft. The photos were taken with a Sony digital camera, a digital microscope camera, and a 20X microscope.

RESULTS AND DISCUSSION

The following photos (Fig. 2) document changes in size, shape and color of the developing seed cones. It is interesting that changes in color occur very quickly after the release of pollen in the area, implying fertilization is not long-delayed. Because Ottley (1909) reported that fertilization varied between 1-2 months (*J. virginiana*) to 1 year (*J. communis*), it is difficult to ascertain when fertilization is occurring in *J. arizonica*. It could be as long as a year after pollination, but because *J. arizonica* is phylogenetically closer to *J. virginiana* than *J. communis* (Adams, 2014), it may be that the time is also short (1-2 months) as in *J. virginiana*. In addition, Fechner (1976) argues that the shorter time from pollination fertilization in *J. virginiana* is correlated with the maturity of seeds in one year, versus 3 years for *J. communis* (with a time of one year between pollination and fertilization). Because the seed cones of *J. arizonica* mature in one year, their time from pollination to fertilization is likely short.

The development of seed cones may not be a sign of successful pollination. Fechner (1976) noted that in *J. virginiana* and *J. scopulorum* no differences were found in the size of filled and empty seeds. The deposition of pollen onto the stigma appears to trigger a mechanism which starts ovular development. Doroshenko (1928) theorized that the function of pollen in ovules is physical and that development could take place without fertilization. Fechner (1976) found that the germination of wind-pollinated seeds was lower than controlled-pollinated seeds from the same mother trees. He speculated this might be due to the presence of foreign pollen (eg. from another, nearby juniper species, such as cultivated *J. chinensis* and *J. sabina*). The alien juniper pollen could bring about seed development without a viable embryo. Recently, Adams, Thornburg and Corbet (2014) surveyed several *Juniperus* species for the incidence of empty vs filled seed cones. They reported *J. arizonica*, Cottonwood, AZ, had 34.4% (2010) and 33.4% (2011) filled cones. *Juniperus osteosperma* from nearby Sedona, AZ, had 79.0% (2010) and 7.2% (2011). They did not consider the fact that their *J. arizonica* population was nearly 100% *J. arizonica*, whereas the *J. osteosperma*, near Sedona, was growing near four other native juniper species, plus cultivated junipers nearby. The low incidence of filled seeds in 2011 (7.2%, *J. osteosperma*) might have been influenced by adjacent juniper pollen. In any case, it should be noted that our photos may well record seed cones with both filled and empty seeds.

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Figure 2. Photos of the development of seed cones of *J. arizonica* from 20 Jan. - 5 Nov. 2014.